STAGE 3 CONTRACT REPORT

Contract Reports. Methods for determining the benefits of safety audit. A scoping study
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M. L. (Mike) Gadd *C. Eng., MICE ,FIPENZ , Registered Engineer.*

MIKE GADD & ASSOCIATES

Civil and Transportation Engineers, 2/63 Rountree Street Christchurch 4
tel/fax (03) 348 - 3710, Mobile 025-376-325

THE BENEFITS OF SAFETY AUDIT

STAGE 3 REPORT

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M. L. Gadd

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This report is organised as follows:

BENEFITS OF SAFETY AUDIT

STAGE THREE REPORT

1. PURPOSE OF THIS STUDY

The purpose of this study is to investigate the benefits of safety audit in the aspects reported in the stage 2 report, sufficiently to indicate whether the methodology devised holds sufficient promise to justify a further more detailed or comprehensive research project to be mounted. It was not expected that definitive results would emerge from this project, or that significant differences between audited and unaudited schemes would be revealed. Sources of information would be listed.

The avenues of research included the "Surrey" method, the "Corben" method, awareness of safe design practice, the efficiency of the process, and the possibility of a creating a data base relating safety audit findings to other data pertaining to roading schemes. The methodology for each of these will firstly be described.

2. METHODOLOGY - GENERAL INTRODUCTION

Most of the terms are based on that described in the Guidelines to Safety Audit, Transit New Zealand 1993. The term "problem" is used exclusively to apply to ***problems*** (or similar terms) used in reports, found in designs or on site.

The following topics were selected as being worth further investigation.

2.1 Methodology - the "Surrey Method".

The basis of this approach is a study carried out by the Surrey County Council staff in the UK. A sample of 30 safety audited traffic/safety improvement schemes and a similarly sized sample of un-audited schemes were compared in terms of reported injury accidents over a period of years before and after reconstruction. It was found that the safety audited schemes had a superior accident rate. The Surrey study is described in greater detail in the stage 2 report

The present study was not intended to include a large enough sample to give a positive and statistically significant result. Also insufficient time had elapsed since construction to give meaningful results in virtually every case. A small sample of schemes in the Canterbury area was analysed to see if a suitable methodology could be devised for further trialing on a larger scale, or as a platform for longer term monitoring of safety audited schemes.

2.2 Methodology - the "Corben Method"

Bruce Corben of Monash University, Victoria, Australia, suggested a method based on the accident potential of problems found in safety audits. If a list of accident rates related to problems in road layouts could be devised, it could be used to predict the savings in accidents resulting from the detection and remedying of the fault. No such list exists (dare we say "yet"?) but the factors reported by the LTSA are given in the appendix as a starting point or inspiration.

This report takes a sample of Canterbury area (Transit New Zealand) safety audits and non- audited schemes and a sample of Christchurch City audited schemes and attempts to demonstrate the potential of the Corben Method. Alternatively, a variation of that approach was investigated to trial a method of assessing the effectiveness of safety audits. For instance, it could be argued that if an audit revealed more than a certain number of problems of sufficient accident potential, it was worth doing. Secondly, if problems could in any way be related to potential accident savings, the method would be worth developing further.

2.3 Methodology - measuring improved awareness of safe design practices.

The basic proposition is to test the hypothesis that the awareness of safety audit leads in turn to greater awareness of safe design practices, and - if possible - the greater acceptance by roading authorities that safety should have a higher priority in decision making.

If safety audits over a period of time showed a declining number of problems being detected (and the quality of audits was similar), then it could be argued that the process was being effective in improving designs from the safety point of view. To demonstrate this trend it would be necessary to rate the number of problems per audit and their severity as described in 2.2 above, and monitor audited site for accidents over a longer period. To enable this to be done it appears essential to create a data base of safety audits and audited sites.

A more direct but somewhat subjective approach would be to distribute a questionnaire to persons involved in traffic and roading design and find out their awareness of, and possible change of attitude resulting from the process of safety audit. such a questionnaire is described later.

2.4 Methodology - basis for creation of a data base of safety audited schemes.

A data base is not really a benefit as such, rather a possible avenue for creating a system which would help monitor the results of safety audits and hence assist the realisation of benefits in the future and spread awareness of the topic.

Possible adaptations of an existing data base - the AIS programme operated by the LTSA, and its derivative accident monitoring programme, are discussed later.

2.5 Methodology - the efficiency of the process of safety audit

Ideally the use of safety audit should result in safer schemes. A comparison of safety audited schemes versus non-audited schemes should indicate the value of the process. In the absence of sufficient data this comparison is looked at in this research project using a ranking system which is described under the "Corben" method.

It is possible that safety auditors could on occasion fail to recognise all potential problems or for some reason the results are not reported to the client or the designer fails to make the necessary changes. Any shortcomings in this area will mean that a safety audit would fail to deliver all the potential benefits. In other words there is a negative or "dis-benefit". This topic is therefore worth investigating under the broad heading of "benefits of safety audit". It is also possible to indicate shortcomings in the application in practice of the safety audit process. This lies

outside the brief of the present study but it would be of value to indicate areas of concern for a possible study or revue of the system. Observed problems are reported in the appendix to the main report.

2.6. Methodology - The common process to evaluate these methods

The methodology adopted set out to make use of a selection of safety audited and unaudited roading schemes. The reports and data were then used for all three aspects studied: The "Surrey" method, the "Corben" method, and the efficiency of safety audits. In the initial stages of each method, a common approach was used.

The following table illustrates the general methodology investigated:

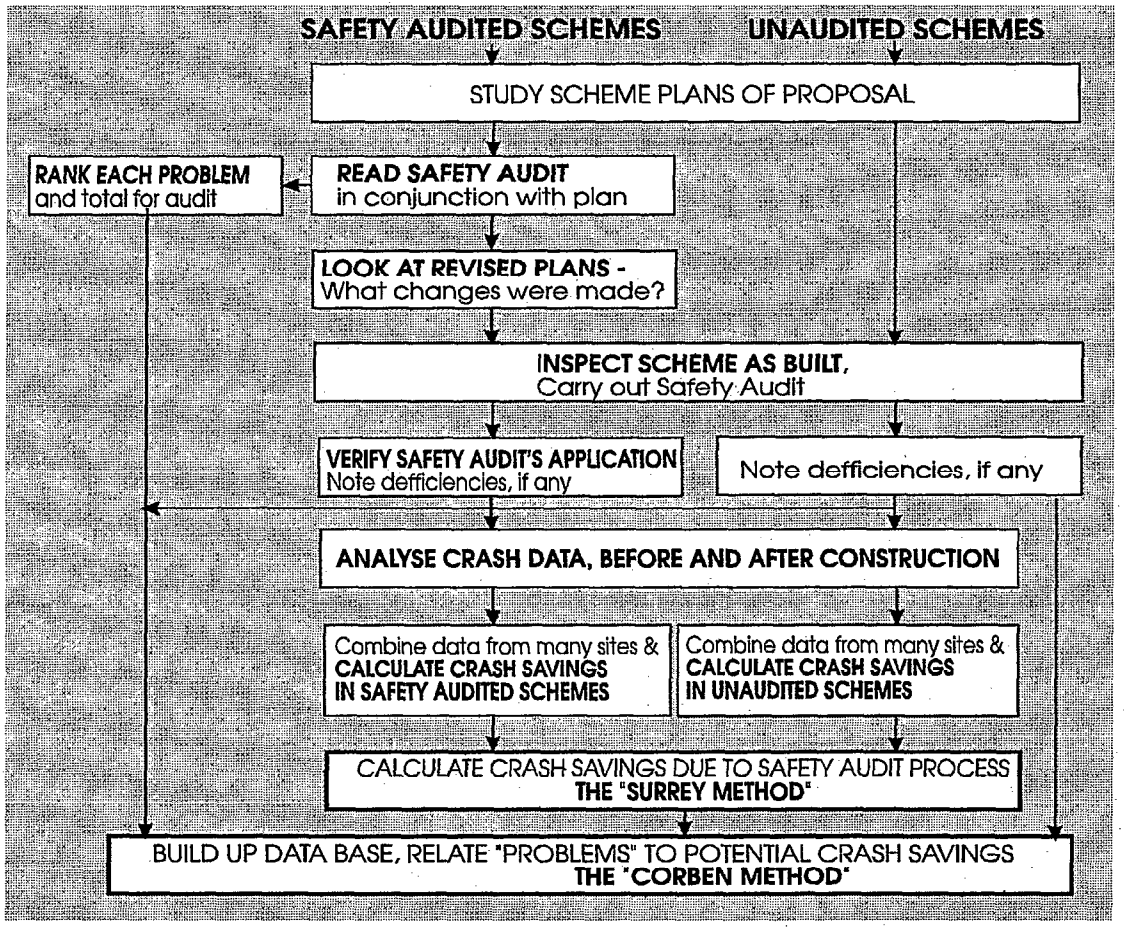

Table 1 - Methodology for this project

The methodology investigated aimed at evaluating detected and omitted problems in designs, safety audits, and on the finished schemes. It was not possible to relate these to crash data (actual or potential or saved) due to the variable quality of data in the Accident Investigation System of the Land Transport Safety Authority, and the lack of sufficient time before and after construction. In an attempt to overcome this, to some extent, a system of ranking the severity of "problems" was devised.

The methodology has promise and would be worth further trials and investigation. It is described more fully under the detailed description of the "Corben" method in section 5 below.

3. THE SELECTION OF PROJECTS

The following projects were selected to test the methods adopted for analysis of crash data, review of safety audits, and site inspection either to confirm the application of safety audits, or - if present - the deficiencies which might have been detected if the scheme had been safety audited. It was not intended, nor expected, that significant benefits would be revealed in so small a sample, and having regard to the short period in which safety audit had been available and a requirement for some schemes (only) to be audited.

Schemes with safety audits	**Schemes without safety audits**
1. Buntings Creek; State Highway 1 *(Transit New Zealand*	1 Russley / Memorial roundabout. State Highway 1. *(Christchurch City council and Transit New Zealand)*
2. Northcote Expressway; State highway 74 to Marshlands Road *(Christchurch city Council)*	2. Broken River Bridge and approaches; State Highway 73. *(Transit New Zealand*
3. St Annes lagoon: State Highway 1 *(Transit New Zealand)*	3. Conway North, State Highway 1. *(Transit New Zealand)*
4. 2. Saltwater Creek shape correction, State Highway 1. *(Transit New Zealand)*	4. Harris Creek to Donegals State Highway 73. *(Transit New Zealand)*
5. Windy Point shape correction, State Highway 7. *(Transit New Zealand)* Stage 2 and 4	5. Sullivans Elbow to Giants Grave; State Highway 6. *(Transit New Zealand)*
Additional safety audits in which the researcher was directly involved	
1. Harewood rd./ Russley / Johns Road roundabout *(Transit New Zealand)*	
Christchurch City Council audited schemes which were appraised for the number and severity of problems	To date no comparable group of unaudited schemes has been selected However, one scheme was investigated:
1. Avonside Drive/Gayhurst/Gloucester	1. The Russley/Memorial roundabout.
2. Colombo/Tennyson	
3. Dilworth/Clarence	
4. Springs Rd/ Halswell Rd roundabout	
5. Moorhouse Av. 6 laning	
6. The Northcote Expressway	

Table 2 - Schemes with and without safety audits selected for study

The ten year accident printouts for the Transit New Zealand schemes are included in the appendix.

In extracting accident statistics it was concluded that the use of a grid coordinate for the approximate mid-point of the scheme and a "radius" to include all the scheme was a satisfactory approach. There proved to be little difficulty in extracting information on injury and non injury accidents. The grid coordinates of each collision are presently worked out and entered by the LTSA. Information contained in a typical five year plan of proposals of Transit New Zealand (the example studied being for the Canterbury region) does not at present include a grid reference. The year of construction is a specific year which is perhaps not as useful as fuller data containing the month as well.

(Windy point SH7 was also addressed but rejected in order to have only five sites of each type - audited and unaudited. There were also no recorded injury collisions at Windy point though several were known to the LTSA. There is considerable general concern about the quality of data.)

The original intention was to select audited and unaudited schemes in two groups, rural and urban. Christchurch city tend to give all roading schemes a "qa"". exercise and to date only audited schemes have been looked at, with the exception of the Russley rd. / Memorial Avenue roundabout, which performed so well.

Dealing now with each topic in greater detail and describing the approach in each case:

4. THE "SURREY" METHOD

The accident analysis of each TNZ site is given in the appendix.

Firstly, the success of this method (as a full scale trial) depends on the availability of sufficient and reliable data. This was not found in the small sample analysed, and no clear picture emerged. It is possible that other regions would have more useful data, in particular where more urban schemes have been safety audited.

No attempt was made to combine data in the manner used in Surrey, as the lack of post-construction data in the sample provided by Transit New Zealand (Christchurch) would make comparisons meaningless. This was to be expected as the practice of safety audit has only been in existence for three years. Some schemes had few or no recorded crashes before or after.. This reflects the fact that only a portion of roading schemes are driven by safety considerations.

As just mentioned, it is apparent that busy - perhaps more urban - roading schemes will more readily acquire the necessary data. The reporting rate is also generally better in urban areas. (Perhaps this line of argument can be extended to remark that given these facts and also the greater scope for detecting and removing design faults, urban or busier roads are a better investment in safety audit than relatively straight forward rural arterial schemes.)

It would be possible to seek and select schemes throughout the whole country which had longer and accurately measured post construction periods but this would have required considerable personal contact and effort.

However, the purpose of this project is to see if the basic methodology is sound It is believed that this has been demonstrated with the proviso that improved data handling would be essential. It seems a justifiable assumption that the creation of a data base would ensure an improvement in data quantity and quality. Another reason for an enlarged or improved data base is the need to compare changes at any roading scheme site with the general accident trend in the area. (A decline in collisions at the site my be offset by a similar decline in the area).

4.1 Conclusions and recommendations - the "Surrey Method"

The method appears to be sound and worth pursuing but to have any hope of demonstrating benefits of safety audit a larger sample is needed and longer periods

post-construction. The fact that it appeared to work in Surrey should justify a larger scale study in New Zealand. There is some concern about data, however. This topic was not fully explored but it is suggested that a worthwhile research project utilising St John's Ambulance and Hospital data would be helpful in research of the type being undertaken here. Perhaps an extension to the study using Manukau City sites and data would be useful. It is recognised that there will be variable reporting rates between different areas, and between different sites in each area.

To develop the "Surrey" method it is necessary to operate a data base approach.

It was found that the LTSA operates the AIS data base which makes use of grid coordinates for each reported crash. With the addition of another field and text the data base can be extended to include safety audits. There would also need to be greater attention and accuracy in the date of construction of improvements. The features and usefulness of the new data base being developed by the LTSA will need to be checked. Details of the present input are included in the appendix.

The accident monitoring sub-programme could also be modified to include the monitoring of safety audit schemes. This programme does make allowance for changes to the reported accident rate in the area.

Given the tendency for roading authorities to select schemes for audit which have the greatest potential for benefit, some method will need to be devised to take account of that fact, in attempting to select comparable groups. It may prove difficult to select comparable groups of audited and unaudited schemes; perhaps a factor approach is needed. On the other hand, local body roads as well as the more urban transit New Zealand schemes appear to offer a fruitful field for extending the use of safety audit (they are generally busier and have greater potential for design faults, as confirmed by the safety audits carried out by the researcher incidental to this project).

The benefits of safety auditing existing networks has not been included in this project but if more widely practiced a monitoring system similar to that suggested in this report appears justifiable. In fact, it is possible that the benefits of correcting faults to existing layouts may, in the long run, prove at least as effective in reducing accidents, than simply checking a sample of roading schemes. These benefits would not only lie in less or less severe crashes, but also in the spread of safe network operation practices.

5. THE "CORBEN" METHOD

At the outset it was felt that it would extremely difficult to demonstrate the differences between audited and unaudited sites as:-

1. There is little data to give accurate accident rates related to various problems.

2. Too little time has elapsed since the safety audited schemes have been in operation.

However, as part of the process of comparing audited with unaudited schemes, a table was devised to log problems observed by auditors, or problems revealed by inspections of plans or sites in the case of unaudited schemes. An example of the

logging sheet follows. Examples of completed sheets and a summary of data are included in the appendix.

It was decided that there was value in the system of assigning (negative) points to each problem listed (or later discovered). Clearly the actual problems and points assigned in any audited scheme depend on at least three factors, firstly the potential number of problems present in the design and site, secondly the severity of the problems, and thirdly the efficiency of the safety audit. (Another factor is the weight attached to each problem by the person assigning points ie me!).

The chief attraction of this method is that not only does it have the potential to be related to the problems discovered and treated, and possibly indirectly accidents, but the method can also be used to measure the efficiency of design, the efficiency of discovery of problems and the potential of completed schemes to still retain potential accident causers.

5.1 The "Corben" Method - recommendations

The method as described by Bruce Corben looks to be worth further investigation. Possibly the LTSA should be asked to investigate the operation of a data base which lists the more serious safety audit problems with the objective of assigning accident rates to each. The LTSA has produced accident rates for some relevant topics but most of these are generalised and may not apply to all problems observed. (Published factors are listed in the appendix)

However, the system of assigning "demerit" points in a list of problems, as suggested in this report, appears to have potential use in:

(a) Providing information about the severity of problems observed. This may, given further study and a larger sample, be related to collisions saved.

(b) Where problems are not identified, or for some reason the design is not modified, or in practice problems occur which were not foreseen, the use of a scale of severity might be related to actual collisions. Alternatively, priorities for remedial action would be assisted by, for example, roads with a large number of demerit points or having a number of serious (high number) problems.

(c) Where the road or intersection as constructed does not provide a clear message to drivers, or their behaviour does not conform to the geometry, or conflicts occur which are attributable to the layout, the demerit point system may also be used to determine the severity of the problems and assist in determining priorities.

The assignment of degrees of severity is subjective and based on the researchers own assessment of each problem. It should in time be possible to assemble more accurate guidelines (if such a move were deemed worthwhile), or safety auditors, who already make use of a three step scale, could be encouraged to rate the severity in slightly greater detail.

There is a tendency for audits to contain only a two step scale; serious problems and comments. This does not contain sufficient detail for application to this method which calls for four degrees of seriousness ie in effect minor/comments plus three degrees of potential for causing accidents.

The method described here is thus different from any previously known method, being in fact a method of expressing problems potentially related to both the Surrey and Corben methods, and as a measure of efficiency of design and safety audit.

As such it is worth considering a wider application of the method, possibly starting off with the application of the method by safety auditors in Transit New Zealand safety audits, and by commissioning a research project with a larger sample than has been possible in this trial

6. MEASURING IMPROVED AWARENESS OF SAFE DESIGN PRACTICES

There appear to be two aspects to this topic:

(a) Improving knowledge of safe design practices as a result of safety audit.

(b) Changing attitudes to safety practice in a wider sense eg by having sufficient reliable data and appropriate priorities to give safety an appropriate place in competing with capacity and longevity.

As there has been no "before" survey it is difficult at present to devise a survey which will yield scientifically based results. Surveys which require respondents to comment on their awareness of techniques or response to new techniques are likely to result in distorted ie excessively positive responses.

However, if respondents remain anonymous and are asked to list suggestions or shortcomings of the system, some useful data might be obtained. The very fact that they are asked to list negative aspects might balance the tendency to overly positive responses, and their answers might be capable of analysis to verify their awareness or lack of awareness of the techniques of safety audit.

A regards the spread of awareness in others ie outside the traffic engineering profession, this is very difficult to determine accurately. Tony Francis and Associates Ltd. has conducted a survey amongst local bodies to determine the use of safety audit. If the traffic or road design staff of local body road controlling authorities are asked their own response to safety audit, a cross reference to their own involvement should be possible. (Staff working for authorities practicing safety audit should be more influenced by safety audit than those who do not.)

The draft questionnaire below has been devised and commented on by a small group of persons involved in either roading matters or opinion seeking exercises

6.1 Improved awareness of safe design practices - recommendations.

It is proposed that this questionnaire (or one based on it) be distributed to a wide cross section of traffic and road safety practitioners.

The membership of the Transportation Group of IPENZ should include all of the above, while recognising that a large proportion will have little to do with road safety. Attempting to survey a 100% sample of the membership appears justifiable.

The analysis will be useful in determining not only the awareness of safety audit, but could assist in identifying future policies and, for instance, the requisite knowledge and experience needed to take part in safety audits.

To all members of the Transportation Group (accompanying the "Roundabout" with a pre-paid return envelope).

BENEFITS OF SAFETY AUDIT

One of the ways of measuring benefits form safety audit is to find out what effect, if any, the process has had on road designers and designs. Would you take a few minutes to complete the following questionnaire and drop in the out tray or mail?

1. Are you aware of the process of safety audit? y/n

2. Do you understand the purpose of safety audit? y/n

3. Are you involved in the geometric design of roads .....y/n
   Traffic management ?.....y/n
   road layouts? .....y/n
   safety studies? .....y/n

4. Do you or your employer make use of the practice of safety audit
   (Tick the statement which best represents the degree of use)

   Frequently ____.....(approximate % of jobs)_____
   Seldom_____.....
   Never_____.....

5. Have you attended a course on the topic? y/n

6. Have you taken part in a safety audit as a member of the team? y/n

7. Are you now more aware of safe design practice than before the introduction of safety audit y/n

8. If the answer to 7. is "y", in what areas (Please state, using the attached list as a reference - or you can tick the appropriate topics on that list and return it to me
.....
.....

9. Are you aware of any shortcomings of the method or its application in New Zealand, have you any suggestions as to how these can be remedied or the method improved?
.....
.....

10. Do you believe the influence of safety audit on non-audited schemes has been beneficial? (y/n)

11. If you carry out or obtain regular checks on crash statistics with a view to addressing the more serious concentrations or "black spots", have you any analysis which would be useful in identifying the effects of safety audits ie the comparison of audited to unaudited schemes? (Please state or write on a separate sheet)

12. Would you be interested in participating in a study to determine the statistical effects of safety audit on crashes, or requesting your local LTSA office to assist?

Thank you. Mike Gadd 2/63 Rountree Street, Christchurch 4, tel/fax (03) 348-3710

Table 3 - Draft Questionnaire to determine knowledge and use of safety Audit

7. A DATA BASE OF SAFETY AUDITED SCHEMES

The objective is to investigate the possibility of creating a data base of schemes that have been safety audited so that the schemes can be monitored for crash statistics and a record is accessible to obtain details of the safety audit recommendations.

The present accident data base scene is in a state of flux with a replacement for the Accident Investigation package of the LTSA being replaced and an inventory of larger schemes being investigated in Wellington.

However, whatever form the Road Safety Audit (RSA) data base takes, the requirements for data entry and accessibility are similar for all potential candidates.

As part of this feasibility study for the benefits of safety audit, a sample of roading schemes were furnished with grid coordinates and the AIS package addressed to observe the process. Accident printouts are given in the appendix.

The LTSA operate a data base of accident investigation sites as part of the main AIS package, making use of the SAS statistical package. This system uses a code for data entry, including the recommendations of the accident investigation. Grid coordinates are included. (As far as can be ascertained some but not all local authority originating accident investigation sites are included.) Part of the monitoring process is to derive the benefits of safety investigations against a base adjusted for the actual level of crashes reported in the given area. For instance if treated sites show a 15% reduction in accidents and the area as a whole shows a similar decline, there is no benefit recorded for the accident investigation sites.

There is a possibility in the AIS package of inputting schemes which have had a safety audit - by adding a "7" to the 1 - 6 list of fields. It would then be necessary to adopt a supplementary code for problems possibly based on an all embracing checklist, an example of which is also given in the appendix. The LTSA action list could also be used to codify safety auditors recommendations,

The AIS system does not list problems as such, simply remedies. A list of potential problems has been used in the past but is now discontinued. This list is included in the appendix. The researcher for this project also devised a list of problems based on the standard checklists used in the new Zealand guidelines for safety audit. This list was used to assign points to each problem for ranking the severity and this is also included in the appendix.

7.1. Summary and recommendation for further investigation, data base:

1. The data base operated by the LTSA appears to capable of adaptation for monitoring crash data at safety audited scheme locations, supplemented by the accident monitoring package

2. It is necessary to report the grid coordinates of the centre of each scheme and a "radius" to include all of the scheme. Very long schemes may need a box defined by grid coordinates.

3. It is recommended that Transit New Zealand be approached to see if they are prepared to furnish grid coordinates of their scheme approvals for physical changes to the road or intersections geometry.

4. It is practical (in the absence of any other system) to add a "7" to the list of attributes in the AIS package and this can then be cross referred to a list of problems based on a comprehensive checklist or the LTSA's problem list.

5. To operate such a data base ideally it appears to need a directive to road controlling authorities to comply with this request.

6. It is recommended that these proposals be further investigated, possibly by discussion with Transit and the LTSA who are both working on data bases.

7. It is concluded that a data base is highly desirable and possible. It would be essential to nominate the authority managing the data base, and also to define and publicise the data required from safety auditors and road controlling authorities. There does not appear at present to be any onus on either group to furnish information to a central data collection system. There also does not seem to be any formal way of recording action taken as a result of a safety audit.

8. THE EFFICIENCY OF THE PROCESS OF SAFETY AUDIT

If it can be shown that successive safety audits (naturally at different stages) are revealing less problems and/or lower severities, then the system is working. On the other hand, if problems are not reported, or are found in later (eg stage 4) audits either previously not detected or detected but not addressed, then the practice of safety audit has been less than efficient.

The scheme plans of a group of audited and non-audited schemes were examined plus the actual safety audits for the first group and the results at the actual sites examined. The names of the schemes examined with some details are listed in the appendix.

With the notable exception of two urban roundabouts, in the safety audits of which the researcher was involved, few faults were observed during brief site inspections of the five audited and five unaudited schemes. Significant problems were found in both roundabout safety audits.

The observed problems at the sample of ten Transit New Zealand rural schemes (five audited, five unaudited), usually minor in nature, are listed by severity in the appendix, with crash information Problems at the two roundabouts are also touched on.

The following is a summary of general comments based on these site inspections, and which relate to traffic safety:

8.1 Comments relating to observed design faults in the sample examined.

The following problems were noted on inspections of plans and site visits.

1 The chosen design speed is significantly lower than the approaches (on an audited scheme)

2 Problems where intersections or accesses are sited on bends - on both audited and unaudited schemes, particularly where additional seal width has been provided on the left and drivers are not using the facility properly. Either drivers are turning at speed from the through lane, and/or drivers on the main route are using the widening as part of their lane.

3 The concrete drain on occasions appears to be partially ineffectual (eg by allowing water or debris on to the carriageway). (A mild comment only, there are clear advantages to the drains in most cases)

4 On embankments the shoulder is sometimes rounded, or is substantially less than the existing road in which the scheme lies. (In effect the standard of the existing road shoulder is higher than the new scheme)

5 Farm gate entrances sometimes appear to be inadequately dealt with.

6 There is occasionally a visual illusion or lack of warning about an approaching feature. The use of wholly or substantially transitional curves in hill country can contribute to this problem

7. **General comment**. The only scheme which appeared to posses significant problems, and which had the benefit of a safety audit is the Saltwater Creek scheme. It is open to conjecture that the other schemes would have benefited from an audit. On the other hand, the Memorial/Russley roundabout, which performs so well was not audited, but witnessed a dramatic (and predicted) drop in collisions. The probably unanswerable question is would it have benefited further from a safety audit? The only appropriate comment from the researchers point of view is that while individual schemes may benefit or not from safety audit, and the process itself may vary, one would expect that given enough data, benefits from safety audit should be satisfactorily demonstrated.

The methodology appears adequate, but a larger sample is needed to demonstrate differences between audited and unaudited sites.

8.2. Comments and conclusions relating to the process of safety audit

1. Schemes with a greater number of reported crashes (before and after) would be expected to yield more significant differences. It is apparent that urban roading schemes, and those involving higher traffic flows and more complicated lane and intersection layouts, are the more profitable sites for safety audit, apparently having the greatest potential for both benefits and errors and omissions in carrying out safety audits

2. Conversely, rural roads built to Transit New Zealand standards and consisting largely of two lane carriageways without intersections or low speed curves, do not always appear to benefit from safety audit.

(One observation from the above comments is that district councils should be persuaded or perhaps coerced into carrying out sufficient safety audits to both result in safer designs and lift the awareness of safe design practices. This would

naturally apply to both in-house and consultant designed schemes. The method of achieving this increase in New Zealand lies outside the scope of this report, but could include favouring audited schemes in the payment of subsidies, or support for the cost of audits in the Safety (Administration) Programme)

3. It is not possible to draw firm conclusions from the site inspections, in relation to the problems detected by the safety audits, due to the small sample. With the exception of the major urban roundabout, most problems seem to have been attended to. There is a slight tendency for rural unaudited schemes to have features which could have been picked up by a safety audit. On the other hand, unaudited schemes can still result in substantial accident reductions. A larger sample, including urban or busy stretches of road or intersections (eg in Manukau City) would be worthwhile. The methodology appears sound.

9. Comments relating to data and information

There appears to be an adequate basis for a data base of safety audits, by modifying the LTSA accident data base. It would be possible to add another field stating where a safety audit had been carried out, when, and what was found.

There is some concern at the quality of accident data both in the area of this study and throughout New Zealand. It is well known that reporting rates vary from district to district. While some allowance can be made for this in a larger scale study, the lack of information on even one or two serious injury collisions can largely invalidate economic justifications for schemes, and make monitoring for crashes related to problems difficult.

It is suggested that it may be economically justified to enlarge the data base to include ambulance call-outs and hospital emergency admission information. It is suggested that a project should be mounted to study this - if such a project has not been already done unbeknown to the author. It seems to be a particularly serious problem in rural areas, particularly well away from base hospitals and medical services. (In the case of Windy Point SH7, it was known that at least three collisions did not appear on the AIS data base.)